CLAIMS

1. In an apparatus for liquid-vapour separation processes, said apparatus comprising, in fluid communication, a liquid distributor 24 and a liquid-vapour separation column 22 tiltable from the vertical, said liquid distributor 24 comprising a primary distribution zone 18 and at least one secondary distributor 10, said primary distribution zone 18 being in fluid communication with the or each secondary distributor 10 and the or each secondary distributor 10 having a plurality of liquid distribution apertures 36 providing said fluid communication between the liquid distributor 24 and the column 22, the improvement consisting of:

(i) the distance between the two apertures that are furthest apart in the or each secondary distributor 10 (the "characteristic length") is such that the liquid distributor 24 provides, at each angle of tilt, a standard deviation of liquid flow rates through the apertures of the or each secondary distributor 10 that is less than a first predetermined maximum for all angles of tilt; and

(ii) the difference in flow rate between the aperture having maximum liquid flow and the aperture having minimum liquid flow in the or each secondary distributor 10 at each angle of tilt is less than a second predetermined maximum for all angles of tilt,

said first and second predetermined maxima being determined by the required degree of liquid-vapour separation.

2. The apparatus of Claim 1 wherein the liquid distributor 24 provides uniform or substantially uniform liquid flux per element.

3. The apparatus of Claim 1 wherein the characteristic length (ℓ_c) is calculated according to the following equation:

$$\frac{Q_{i-j}}{Q_{ave}} = A.C_D\left(\sqrt{\frac{2.\delta\rho}{\rho}}\right)\left(\sqrt{h_i} - \sqrt{h_i - l_c.\sin\theta}\right)$$

where Q_{i-j} = difference in volumetric flow rate between apertures i & j;

Q_{ave} =average flow through the apertures;

A = cross-sectional area of aperture;

C_D = aperture discharge coefficient;

$\delta\rho$ = difference between liquid and vapour density;

ρ = liquid density; and

h = height of liquid above aperture.

θ = angle of distributor tilt.

4. The apparatus of Claim 1 wherein the total cross-sectional area of said primary distribution zone 18 defined by the outer periphery thereof is less than the corresponding total cross-sectional area of the secondary distributor(s) 10.

5. The apparatus of Claim 1 wherein the diameter of the column 22 is no more than the characteristic length, said liquid distributor 24 comprising one secondary distributor 10.

6. The apparatus of Claim 1 wherein the diameter of the column 22 is more than the characteristic length, said liquid distributor 24 comprising a plurality of secondary distributors 10.

7. The apparatus of Claim 1 wherein the column 22 is packed in a plurality of sections 32 and the liquid distributor 24 has a separate secondary distributor 10 provided for distributing fluid to each section 32.

8. The apparatus of Claim 7 wherein the interrelationship between the arrangement of the or each secondary distributor 10 and the arrangement of the plurality of column sections 32 is such that the uniformity of liquid flux per element is increased relative to that for apparatus not characterised by features (i) and (ii) defined in Claim 1.

9. The apparatus of Claim 1 wherein the column is packed in a plurality of sections 32 and the or each secondary distributor 10 is provided to distribute fluid to more than one section 32.

10. The apparatus of Claim 1 wherein the liquid distributor 24 comprises a plurality of secondary distributors 10 in an arrangement having a core secondary

distributor surrounded by at least one ring of secondary distributors, said ring being concentric with the core secondary distributor.

11. The apparatus Claim 1 wherein the liquid distributor 24 comprises a plurality of secondary distributors 10 in a "chess board" arrangement.

12. The apparatus of Claim 1 wherein the primary distribution zone 18 is at least partially filled with packing.

13. The apparatus of Claim 1 wherein the or each secondary distributor 10 is at least partially filled with packing.

14. The apparatus of Claim 1 wherein the liquid distribution apertures 36 are arranged in a plurality of lines, the or each secondary distributor 10 further comprising at least one liquid flow divider 34 between at least some of said lines.

15. The apparatus of Claim 1 wherein the or each secondary distributor 10 has a base having a thickness that is greater than the diameter of each liquid distribution aperture 36.

16. The apparatus of Claim 16 wherein the thickness of the base is at least twice the diameter of each liquid distribution aperture 36.

17. The apparatus of Claim 1 wherein the or at least one secondary distributor 10 is divided into two or more compartments 26, each compartment 26 being in fluid communication with each other compartment 26 within said secondary distributor 10.

18. The apparatus of Claim 17 wherein the secondary distributor 10 is substantially circular having a number of sectors, each sector being a compartment 26.

19. The apparatus of Claim 1 wherein the column 22 is packed in sectors 32 about the longitudinal axis of the column, each sector 32 comprising a plurality of vertical sheets of structured packing arranged in parallel in tangential planes to the column axis and the liquid distribution apertures 36 are arranged in a plurality of rectilinear lines

extending radially from the column axis, said lines traversing the planes of said packing sheets.

20. The apparatus of Claim 1 wherein the primary distribution zone comprises one primary distributor 18, the or each secondary distributor 10 being fed from the primary distributor 18 via a plurality of openings 42 in the base 40 of the primary distributor 18, said openings 42 being evenly distributed in a region of the primary distributor base 40.

21. The apparatus of Claim 20 wherein the primary distributor 18 is located outside the column.

22. The apparatus of Claim 1 wherein the total cross sectional area of the secondary distributor(s) 10 is from 60% to 95% of the total cross sectional area of the column 22 with the remaining area being substantially taken up by vapour vents.

23. The apparatus of Claim 22 wherein the total cross sectional area of the secondary distributor(s) 10 is about 90% of the cross sectional area of the column 22 with the remaining area being substantially taken up by vapour vents.

24. The apparatus of Claim 1 wherein the liquid distributor 24 comprises one secondary distributor 10, said secondary distributor 10 being an integral part of the primary distribution zone 18.

25. The apparatus of Claim 1 adapted and/or constructed for cryogenic distillation.

26. The apparatus of Claim 1 further comprising a liquid re-distributor 52 provided at an intermediate location in the liquid-vapour separation column 22, said liquid re-distributor 52 having the features of the liquid distributor defined in Claim 1.

27. The apparatus of Claim 26 wherein the liquid re-distributor 52 comprises the same features as the liquid distributor 24.

28. A liquid distributor 24 for use in liquid-vapour separation processes, said liquid distributor 24 comprising a primary distributor zone 18 and at least one secondary distributor 10, said primary distributor zone 18 being in fluid communication with the or each secondary distributor 10 and the or each secondary distributor 10 having a plurality of liquid distribution apertures 36, said liquid distributor 24 being characterised in that the total cross sectional area of said primary distributor zone 18 defined by the outer periphery thereof is less than the corresponding cross sectional area of the or each secondary distributor 10.

29. An off-shore floating tiltable platform comprising apparatus that comprises, in fluid communication, a liquid distributor 24 and a liquid-vapour separation column 22, said liquid distributor 24 comprising a primary distribution zone 18 and at least one secondary distributor 10, said primary distribution zone 18 being in fluid communication with the or each secondary distributor 10 and the or each secondary distributor 10 has a plurality of liquid distribution apertures 36 providing said fluid communication between the liquid distributor 24 and the column 22, said platform being characterised in that:

(i) the distance between the two apertures that are furthest apart in the or each secondary distributor (the "characteristic length") is such that the liquid distributor provides, at each angle of tilt, a standard deviation of liquid flow rates through the apertures of the or each secondary distributor that is less than a first predetermined maximum for all angles of tilt; and

(ii) the difference in flow rate between the aperture having maximum liquid flow and the aperture having minimum liquid flow in the or each secondary distributor at each angle of tilt is less than a second predetermined maximum for all angles of tilt,

said first and second predetermined maxima being determined by the required degree of liquid-vapour separation.

30. Use of apparatus comprising, in fluid communication, a liquid distributor 24 and a liquid-vapour separation column 22 tiltable from the vertical, said liquid distributor 24 comprising a primary distribution zone 18 and at least one secondary distributor 10, said primary distribution zone 18 being in fluid communication with the or each secondary distributor 10 and the or each secondary distributor 10 having a plurality

of liquid distribution apertures 36 providing said fluid communication between the liquid distributor 24 and the column 22, said apparatus being characterised in that:

(i) the distance between the two apertures that are furthest apart in the or each secondary distributor 10 (the "characteristic length") is such that the liquid distributor 24 provides, at each angle of tilt, a standard deviation of liquid flow rates through the apertures of the or each secondary distributor 10 that is less than a first predetermined maximum for all angles of tilt; and

(ii) the difference in flow rate between the aperture having maximum liquid flow and the aperture having minimum liquid flow in the or each secondary distributor 10 at each angle of tilt is less than a second predetermined maximum for all angles of tilt,

said first and second predetermined maxima being determined by the required degree of liquid-vapour separation,

to provide uniform or substantially uniform liquid flux per element.

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